

Water spinach (*Ipomoea aquatica*) and Taro leaves (*Colocasia esculenta*) as a rust remover

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Abstract:

Corrosion is the deterioration of materials, mainly metal, as a result of a chemical reaction with the environment, which causes a component to fail to function properly (Harsimran et al., 2021). This study explores the potential of utilizing taro leaves and water spinach as alternative organic rust removers. Both plants Ipomoea aquatica and Colocasia esculenta are known for their natural compounds, and their effectiveness in removing rust is investigated through a series of experiments. The leaves are processed into an extraction, and their oxalate is compared to conventional methods. There are three experimental ratios; 1:3, 3:1, 1:1. It appears that 3:1 is the best ratio in terms of inhibiting corrosion behavior, with these kinds of metals; i.) Wrought Iron; ii.) Stainless Steel; iii.) Galvanized Steel. The statistical data shows that the null hypothesis is rejected and 3:1 ratio is comparable and even better than the commercial rust remover with the result of rust removal values were 0.329, 0.122, and 0.121 at the same time intervals, with a percentage reduction in rust ranging from 32.9% to 12.2% with Wrought Iron. While with Stainless Steel, the result is showing an increase in rust removal from 1.2% to 6.6%. suggesting its superior efficacy in the testing of three metals.

Key words: corrosion; Ipomoea aquatica; Colocasia esculenta; oxalate

1. INTRODUCTION

Among the issues brought by climate change, rust appears as a key issue with far-reaching consequences for numerous businesses. Its corrosive effects on infrastructure and machinery jeopardize their integrity and entail significant expenses (Mkawe, 2023). Traditional rust removal technologies frequently pose sustainability problems since they rely on fossil fuels. In response, research into sustainable alternatives, particularly those derived from renewable resources, is gaining traction (Verma et al., 2021). The research on using water spinach and taro leaves as a rust remover contributes to Sustainable Development Goal. Responsible, Consumption and Production, bv promoting environmentally friendly alternatives, supporting innovation, and advocating for responsible consumption and production practices.

2. METHODOLOGY



Figure 1. Methodology Flowchart



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3. RESULTS AND DISCUSSION

The study was based on So'n et.al 2021. Preparation and Evaluation of Rust Removal Solutions for Anti-Corrosive Properties.

It uses the initial weight (M1), and mass after rust removal (M2), and rust removal (M). It uses the unit grams

RATIO	TIME	M1	M2	М	% Rust Removed	Mean	Standard Deviation
	1 (30MINS)	2.435	2.431	0.004	0.4		
1:3	2 (60MINS)	2.488	2.477	0.011	1.1	1.16	0.65
	3 (90MINS)	1.490	1.470	0.02	2		
	4 (30MINS)	2.464	2.252	0.012	1.2		
3:1	5 (60MINS)	2.560	2.543	0.017	1.7	1.56	0.26
	6 (90MINS)	1.344	1.326	0.018	1.8		
	7 (30MINS)	1.448	1.444	0.004	0.4		
1:1	8 (60MINS)	1.454	1.439	0.015	1.5	0.66	0.60
	9 (90MINS)	1.352	1.351	0.001	0.1		

Table 1: Rust Removal Properties of the Three Ratios (1:3,3:1, 1:1) with Stainless Steel

The 3:1 ratio as the optimal choice for rust removal in the specific application under investigation.

RATIO	TIME	M1	M2	м	% Rust Removed	Mean	Standard Deviation
	1 (30MINS)	1.17	1.085	0.085	8.5		
1:3	2 (60MINS)	1.22	1.134	0.086	8.6	8	0.778
	3 (90MINS)	1.17	1.101	0.069	6.9		
	4 (30MINS)	1.39	1.064	0.329	32.9		
3:1	5 (60MINS)	1.18	1.058	0.122	12.2	19.06	9.78
	6 (90MINS)	1.00	0.879	0.121	12.1		
	7 (30MINS)	1.53	1.480	0.05	5		
1:1	8 (60MINS)	1.19	1.058	0.132	13.2	11.2	4.475
	9 (90MINS)	1.11	1.016	0.154	15.4		

Table 2: Rust Removal Properties of the Three Ratios

 (1:3, 3:1, 1:1) with Wrought Iron

The 3:1 ratio stands out as the preferred choice for effective rust removal on wrought iron in the tested conditions.

RATIO	TIME	M1	M2	М	% Rust Removed	Mean	Standard Deviation
	1 (30MINS)	1.818	1.742	0.076	7.6		
1:3	2 (60MINS)	2.553	2.358	0.195	19.5	13.8	4.87
	3 (90MINS)	2.116	1.973	0.143	14.3		
	4 (30MINS)	2.022	1.724	0.298	29.8		
3:1	5 (60MINS)	1.930	1.868	0.062	6.2	34.83	25.68
	6 (90MINS)	2.393	1.708	0.685	68.5		
	7 (30MINS)	1.963	1.794	0.169	16.9		
1:1	8 (60MINS)	2.093	2.000	0.093	9.3	10.93	4.36
	9 (90MINS)	2.213	2.147	0.066	6.6		

Table 3:	Rust Removal	Properties	of the	Three	Ratios
(1:3, 3:1, 1	1:1) with Galvar	nized Steel			

the 3:1 ratio emerges as the preferred choice for effective rust removal on galvanized steel under the tested conditions.

STAINLESS STEEL							
TIME	3:1	1:1	1:3				
30	2.395	1.244	1.301				
60	2.394	1.243	1.299				
90	2.394	1.242	1.293				
120	2.391	1.237	1.293				
150	2.391	1.235	1.292				
180	2.39	1.231	1.29				

Table 4 : Stainless Steel using the Three ratios WL:TL (3:1, 1:1, 1:3) Remover product within 180 seconds

This study examined the speed of rust removal on different metals.

WROUGHT IRON						
TIME	3:1	1:1	1:3			
30	0.94	0.534	1.301			
60	0.929	0.514	0.828			
90	0.925	0.502	0.822			
120	0.924	0.491	0.814			
150	0.921	0.483	0.801			
180	0.897	0.482	0.791			



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Table 5 : Wrought Iron using the Three ratios WL:TL (3:1,1:1, 1:3) Remover product within 180 seconds

Overall, the experiment demonstrates the efficacy of the rust remover solutions in eliminating rust from wrought iron surfaces, regardless of the ratio used.

GALVANIZED STEEL							
TIME	3:1	1:1	1:3				
30	0.987	0.767	1.316				
60	0.977	0.754	1.297				
90	0.964	0.744	1.283				
120	0.946	0.734	1.279				
150	0.944	0.728	1.278				
180	0.935	0.714	1.255				

Table 6 : Galvanized Steel using the Three ratios WL:TL (3:1, 1:1, 1:3) Remover product within 180 seconds

Overall, the outcomes demonstrate how well the rust remover solutions work.

COMMERCIAL PRODUCT							
TIME	STAINLESS STEEL	WROUGHT IRON	GALVANIZED STEEL				
M1	1.523	0.674	0.892				
30	1.523	0.670	0.887				
60	1.519	0.668	0.884				
90	1.517	0.663	0.880				
120	1.514	0.660	0.876				
150	1.514	0.660	0.872				
180	1.511	0.657	0.871				

Table 7: Commercial Rust Remover Product using theThree Types of Metals within 180 seconds

Overall, the outcomes demonstrate the effectiveness of the commercial rust remover

VALUE	Source	SS	MS	DF	F-VALUE	P- VALUE
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RATIO	2661 .04	887. 013	3	1.82E+30	0
METAL	5176 .80	2588 .40	2	5.30E+30	0
RATIO METAL	1885 .82	314. 303	6	6.43E+29	0
RESID UE	3.96 E-26	4.89 E-28	81		
TOTAL	9723 .66		92		

Table 8: Two-Way Anova Summary

4. CONCLUSIONS

The null hypothesis was rejected, confirming that there is a significant difference in rust removal effectiveness between the natural mixtures and the commercial rust remover across different metals.

5.RECOMMENDATIONS

It is also advised that future studies use Fourier Transform Infrared (FTIR) analysis to determine the oxalate content of Water Spinach (*Ipomea aquatica*) and Taro Leaves (*Colocasia esculenta*)..

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